

ASSESSMENT OF HEAVY METAL IMPACT ON TOPSOIL PHYSICOCHEMICAL PROPERTIES IN MGBUKA OBOSI MECHANIC VILLAGE, NIGERIA

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Abstract

This study assessed the concentration, distribution, and contamination levels of selected heavy metals in soils from Mgbuka Obosi Mechanic Village, Anambra State, Nigeria, with comparison to a control site at Idemili Farms. Soil samples were collected at depths of 0–30 cm and 30–60 cm and analyzed for heavy metals including cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), and zinc (Zn) using Atomic Absorption Spectrophotometry. Physicochemical properties such as soil pH, moisture content, particle size, bulk density, organic carbon, and nutrient composition were also determined. Results showed higher concentrations of heavy metals in the mechanic village compared to the control site, with the order of abundance as Cu > Fe > Zn > Pb > Cd > Cr. Although most metal concentrations were below permissible limits, contamination factor (CF) and pollution load index (PLI) values indicated moderate contamination, which increased with soil depth. Soil properties revealed slightly acidic conditions, reduced moisture content, and altered nutrient levels in the study area, likely due to continuous anthropogenic activities such as oil spills and metal waste disposal. The enrichment factor (EF) suggested minimal to moderate anthropogenic influence. Overall, the findings highlight potential environmental and health risks associated with prolonged exposure to contaminated soils in mechanic villages. The study recommends immediate intervention and sustainable waste management practices to mitigate further soil degradation and protect surrounding agricultural lands.

Keywords: Heavy metals, Cadmium, Chromium, Copper, Iron, Lead, Zinc, Enrichment Factor, Contamination Factor.

INTRODUCTION

The advent of industrialization has led to a widespread of environmental contamination and pollution. This trend has contributed to the elevated levels of heavy metals in the urban environment especially in the developing countries like Nigeria. Heavy metal contamination of urban topsoil has been of major concern regarding their persistence, toxicity and non-degradability in the environment (Al-Chalabi and Hawker, 2000). The various activities of man in recent years have elevated the amount of distribution of heavy metals in the atmosphere, land and water bodies. Anthropogenic sources of soil contaminations are associated with rapid and uncontrolled urbanization and industrialization (Akinola and Ekiyoyo, 2006). Mechanic villages also introduce heavy metals to the environment. Lead (Pb), originates from the use of leaded gasoline while Cd from tyre abrasion, lubricants, industrial and incinerator emissions (Thorpe and Harrison, 2008).

The study of heavy metal deposition and accumulation is of increasing interest because of the awareness that heavy metals present in soils may have negative consequences on human health and on the environment (Selinus et. al., 2005; Mielke et. al., 2005). Obosi mechanic village began with a few workshops that have since expanded into more shops where auto-mechanic repairs are performed, involving the working and spilling of oils, grease, gasoline, paints, and electrolyte from batteries, resulting in a massive flow of heavy metals discharge into the soil. While an engine is running, the gasoline collects particles of heavy metals such as Lead (Pb), Cadmium (Cd), Chromium (Cr), Iron (Fe), Manganese (Mn), Zinc (Zn), and Copper (Cu).

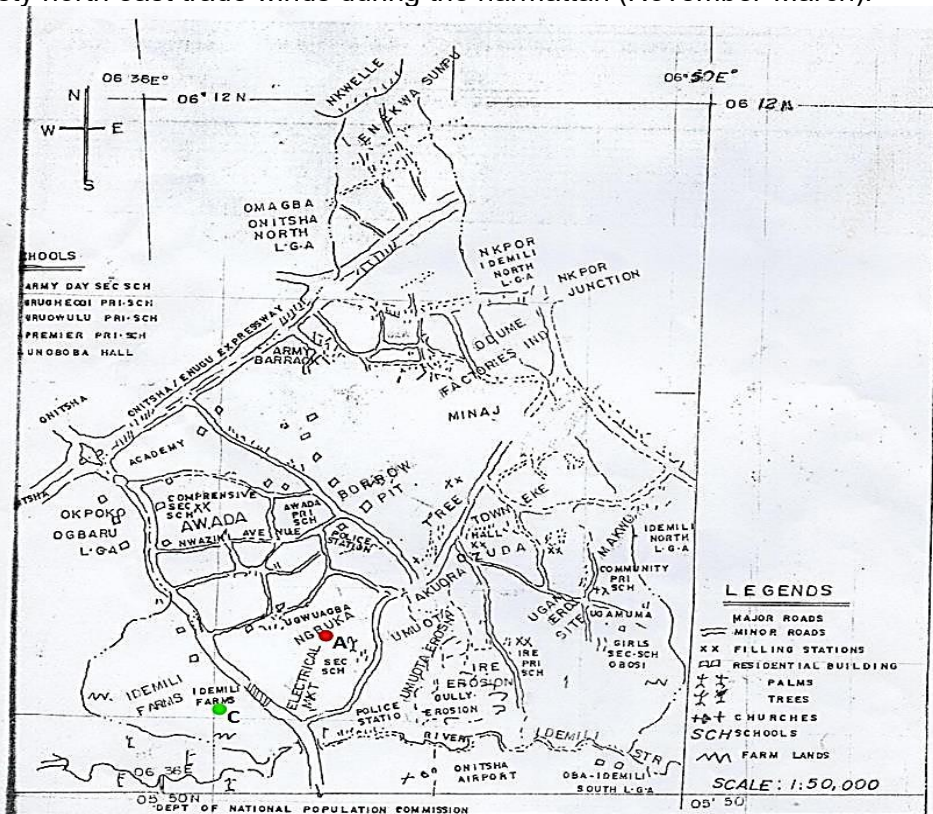
Additionally, engine oil or transmission fluid poured on the ground enriches the soil with heavy metals, which can be drained into both surface and groundwater. Heavy metals will be enriched in the soil as a result of spilled automotive fluid on the ground, as well as metal corrosion processes.

Several heavy metals are naturally occurring in the earth's crust and are used for a variety of industrial and economic reasons. Some of these heavy metals have impact on the soil composition, either directly or indirectly. Copper, Cobalt, Iron, Nickel, Magnesium, Molybdenum, Chromium, Selenium, Manganese, and Zinc are just a few of the heavy metals that have functional roles in the body's physiological and biochemical activity. Automobile junk markets similar to mechanic village can be seen as a center for poverty alleviation. Despite the huge sum of revenue, it is improper to neglect some of the hazards associated with the automobile junk market operations (Nwachukwu et al., 2013a). Thus, since soil pollution creates a significant risk to human health, this study has been designed to determine the concentrations and the degree of contamination of heavy metals in the soils at Mgbuka Obosi Mechanic Village Obosi, Anambra State, Nigeria.

METHODS

2.1 Study Area

The study area is Mgbuka Obosi Mechanic Village, Obosi in Idemili South LGA of Anambra State, situated between latitude 06°06'20.00"N and longitude 06°47'53.00"E, in the humid tropical rainforest zone, Obosi is affected by two main trade winds: lovely and comfortable moist southwest trade winds during the season (April-October) and dry and dusty north east trade winds during the harmattan (November-March).



Source: Dept of National Population Commission, 2020.
Plate 3.1. Map of Obosi Community showing the study area (A) and the control site (C).

Obosi has an annual rainfall of 2000 – 3000mm per annum with an average amount of rainfall, 375mm. Generally, the mean annual rainfall amount is over 2000mm. The relative humidity of this area in January and July respectively falls between 75% and 95% with the mean annual temperature fluctuating between 25.00 – 27.50 (Oboli, 1980). The weather is mostly hot (maximum monthly temperatures range from 27.2°C to 35°C, and minimum temperatures range from 18.2°C to 23°C). The daily average humidity on the ground varies between 40% and 92%. In terms of topography, there are undulating uplands and lowlands. The River, which flows in a north-south direction with tributaries such as the Idemili and Mamu rivers, ends the lowlands and swampy alluvial soils (Okpoko and Egboka, 2008). It is bounded in the east by Nkpor and Umuoji, in the North by Nkwelle–Ezunaka and Onitsha, in the west by Ogbaru and in south by Ojoto as shown in (plate 3.1).

2.2 Soil Sample Collection

The two (2) soil samples were collected from two places at depths of 0-30cm and 30-60cm using hand/soil auger at Mgbuka Obosi Mechanic Village (an automobile mechanic village for dismantling of used vehicle parts and coupling of vehicle parts, battery works, and disposal of used oil and dumps of corroded engines) between latitude 6°6'20.00"N and longitude 06°47'53.00"E. Two (2) soil samples were also collected from two places at depths of 0-30cm and 30-60cm at the control site for this project which is Idemilli Farms (used for agricultural practices such as farming etc.) about 2km far from the study area (Mgbuka Obosi Mechanic Village, Obosi) between latitude 06°4'29.00"N and longitude 06°50'8.00"E. placed in soil sample jars, tightly sealed, and delivered to the lab for analytical testing.

2.3 Materials Used for Soil Sample Collection

The materials in carrying out this research work includes:

- Hand auger
- Soil sample jars
- Shovel
- Metal rule
- Fresh plastic bags

2.4 Determination of Heavy Metals

Heavy metal analysis was conducted using Varian AA 240 Atomic Absorption Spectrophotometer (AAS) according to the method of APHA 1995 (American Public Health Association).

2.4.1 Dry Digestion

2g of the sample was weighed into a crucible and put into a muffle furnace for ashing at a temperature of 450°C for 2hours.

2.4.2 Preparation of Reference Solution

A series of standard metal solutions in the optimum concentration range was prepared, the reference solutions were prepared daily by diluting the single stock element solutions with water containing 1.5ml concentrated nitric acid/litre.

2.5 Determination of the Soil pH

This was done by the use of JENWAY 3510 pH meter

2.6 Nitrogen Content Determination (AOAC, 2000)

A 2g weight of each sample was weighed into a digestion tube. A 15g weight of catalyst (CuSO₄:Na₂SO₄) at 1:10 and 35ml of concentrated sulphuric acid were added. The digestion of each sample was carried out and digestion stopped when solution was clear.

Calculation:

$$\text{Total Nitrogen \%} = \frac{(B-S) \times 1.4007 \times N \times 20}{\text{Sample weight (g)}} \quad 2.1$$

Where:

B = vol (ml) of NaOH solution used for black

S = vol (ml) of NaOH solution used for sample

N = Normality of NaOH

1.4007 = m. eq wt. of nitrogen (includes factors of 100 for %)

20 = Dilution factor (5ml of digest used out of 100ml).

2.7 Soil Particle Size Analysis

Standard test method for particle-size analysis of soils (ASTM D 422) was used for particle size distribution. The weights passing through each sieve were calculated from dry soil, and the cumulative percentage passing was calculated using:

$$\% \text{ passing} = \frac{\text{weight passing each sieve}}{\text{total weight}} \times 100 \quad 2.2$$

2.8 Determination of Soil Moisture Content

This was done using the oven drying method.

$$\text{moisture content (\%)} = \frac{\text{wet weight} - \text{dry weight}}{\text{dry weight}} \times 100 \quad 2.3$$

2.9 Determination of Soil Organic Carbon

Formular for calculating the organic carbon.

$$\text{SOM} = \frac{M_o \times 100}{M_D} \quad 2.4$$

where: M_o is organic matter, M_D is mass of the soil,

2.10 Determination of Bulk density

It was determined as described by Ahmedna et al. (1997).

2.11 Determination of Phosphate

Phosphate was measured using Standard Method 4500-P B.5 and 4500-PE (APHA, 1998).

2.12 Calibration Methods

$$\text{Conc of sample} = \frac{\text{Abs of sample} \times \text{conc of std}}{\text{Abs of st}} \quad 2.5$$

were determined, compared and analyzed using:

2.13 Contamination Factor and Pollution Load Index

The pollution load index (PLI) is the square root of the multiplication of the contamination factor (CF) of metals: where CF (metal) is the ratio between the content of each metal and the background value in sediment and water samples of the study area. The CF and PLI are important because they are used to evaluate the contamination of PTEs, CF value of less than 1 indicate low pollution, CF 1–3 shows moderate pollution, CF 3–6 means high pollution, and CF above 6 indicates very high pollution (Thomilson et. al., 1980; Tian et al., 2017; Wang et. al., 2020).

$$CF (\text{Metals}) = \frac{C(\text{metal})}{C(\text{background})} \quad 2.6$$

$$PLI = (CF_1 \times CF_2 \times CF_3 \times \dots \times CF_n)^{1/n} \quad 2.7$$

2.14 Enrichment Factor (EF)

The Enrichment Factor (EF) calculation described by (Sardans et. al., 2010) below was adopted for this study.

$$EF = \frac{(X/Fe)_{\text{Soil}}}{(X/Fe)_{\text{Background}}} \quad 2.8$$

Where (X/Fe) soil is the ratio of heavy metal (X) to Fe in the soil from the mechanic village (X/Fe) background is the natural background value of the metal to Fe ratio.

2.15 Statistical Analysis

The depth of metal concentrations in the soil of Mgbuka Obosi Mechanic Village and the control area (Idemilli Farms, Obosi) was measured, compared, and analyzed using the Microsoft Excel Analysis of Variance (one-way ANOVA). The study area's soil physical parameters (soil density, particle size, soil pH and soil moisture) was used to determine a relationship to anticipate the link between heavy metals and the soil physical properties.

3. RESULTS AND DISCUSSION

3.1 Effect of selected Heavy Metals concentration on soil depth Mgbuka Obosi Mechanic Village, Obosi

Table 3.1 Effect of Depth on Heavy Metals and other Physiochemical Properties of the Soil at Mgbuka Obosi Mechanic Village Obosi, Anambra State, Nigeria

SITE	Depth (cm)	Heavy Metals concentration (mg/kg)						SO C (%)	N (cm ol/k g)	P (cmol/ kg)	K (cm ol/k g)	Soil pH	Moisture (%)	Density (g/cm ³)	Particle Size (g)
		Cd	Cr	Cu	Fe	Pb	Zn								
A	30	0.475	0.011	27.05	11.50	1.43	10.75	2.20	0.20	73.71	0.18	6.10	7.07	1.37	2.41
A	60	0.630	0.009	26.63	10.375	2.95	13.18	2.97	0.24	74.11	0.23	6.00	6.24	1.23	2.89
C	30	0.351	0.08	20.18	4.170	1.025	6.351	0.95	1.13	43.43	0.11	5.85	8.50	1.22	3.65
C	60	0.355	0.07	20.02	4.083	1.70	5.073	1.23	0.96	44.14	0.15	5.80	9.80	1.25	3.59
WH O	-	0.8	100	36	42.5	85	50	-	-	-	-	-	-	-	-

A = Mgbuka Obosi Mechanic Village, C = Control Site, Denneman and Robberse 1990; Ministry of Housing Netherlands 1994

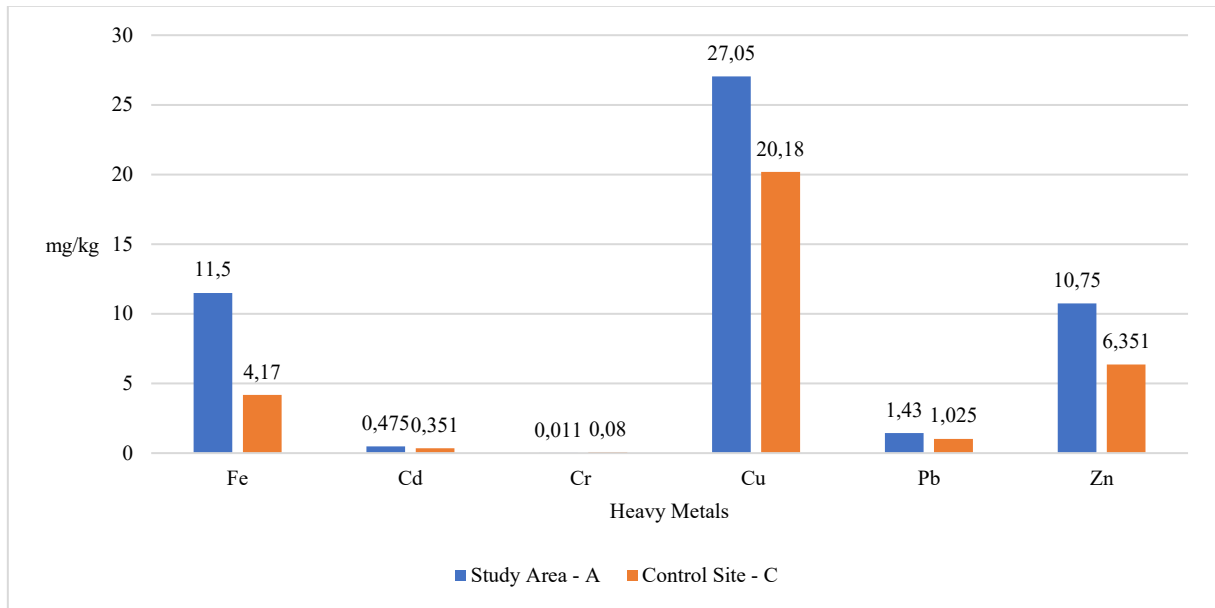


Figure 3.1: Concentration of heavy metals at 0-30cm depths in Mgbuka Obosi mechanic village, Obosi

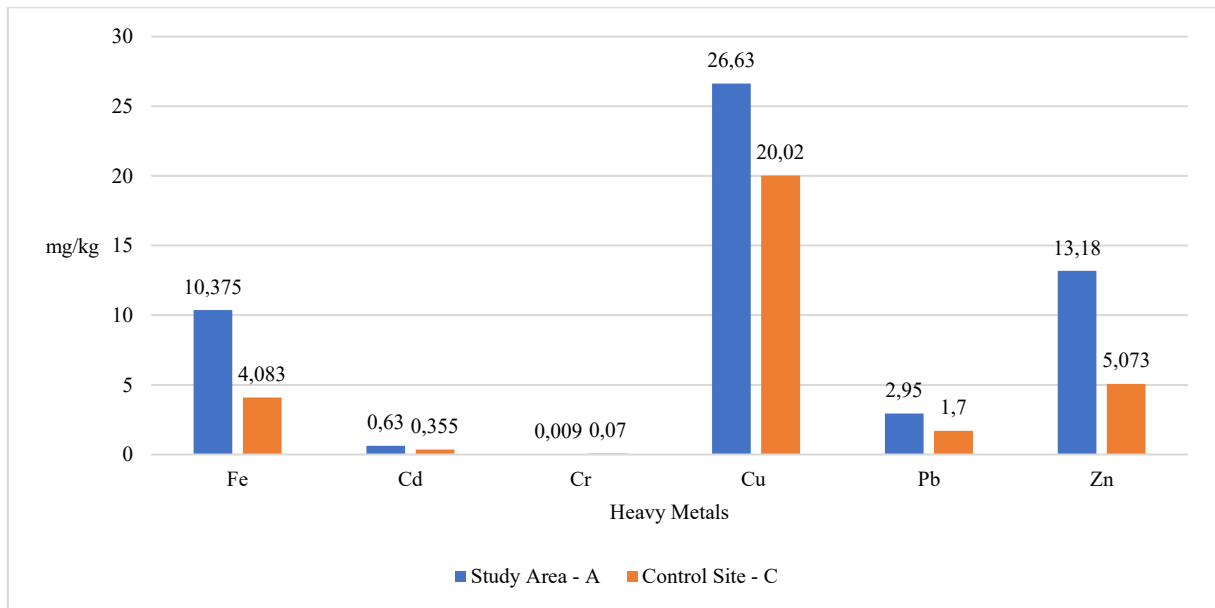


Figure 3.2: Concentration of heavy metals at 30-60cm depths in Mgbuka Obosi mechanic village, Obosi

3.1.1 Effect of Cadmium (Cd) concentration on depth of soil

Although it is known that Cadmium (Cd) is a significant heavy metal contaminant in soil, Table 3.1 shows a significant difference at p0.05 in the amount of Cadmium in the study area (A) at different depths (0-30cm and 30-60cm) compared to the amount of Cadmium in the control site (C) at different depths (0-30cm and 30-60cm). When compared to the maximum allowable limits of 0.8 mg/kg, the levels of cadmium found in the research area sites ranged from 0.351 to 0.630 mg/kg, which is low compared to background (control) values. When compared to chromium levels identified in soil profiles from car workshops (Duru et al., 2020; Kawo et al., 2017).

3.1.2 Effect of Chromium (Cr) concentration on depth of soil

Figure 3.1 and Figure 3.2 shows that there is a significant difference in the amount of chromium (Cr) found in study area A (0-30cm) and study area A (30-60cm), while there is no chromium at the control site (C), despite chromium (Cr) being one of the most strategic and dangerous materials in the world (Jacobs and Testa, 2005). The Chromium (Cr) values in study area sites varied from 0.011 to 0.08 mg/kg when compared to the highest permitted limits of 5.0 mg/kg (see Appendix). Chromium levels in the study area were lower than background values (control). The amounts of chromium discovered in this study were relatively low when compared to the amounts of chromium reported for soil profiles of auto workshops (Afolabi and Eludoyin, 2021; AIP Conference Proceedings, 2015); however, much higher amounts of chromium in soil have been reported for some sites in Nigeria (Popoola and Afolayan, 2020; Nwachukwu et al. 2010). Similar to this, low quantities of chromium have been found in soils contaminated with crude oil and municipal trash dumps (Nwachukwu et al. 2013a; Duru et al., 2010).

3.1.3 Effect of Copper (Cu) concentration on depth of soil

Copper is one of the micronutrients required for both plant and animal growth, and Figure 3.1 and Figure 3.2 shows its high presence in both the study region (A) and the control site (C), with a higher concentration in the study area than in the control site. The mechanic village's extensive use of copper tubes, solder, electrodes, and numerous other copper-based maintenance tools as well as automobile wastes containing electrical and electronic components like copper wires and pipes, electrodes, and alloys from corroding vehicle scraps are responsible for the study area's topsoil's copper content, which ranged between 26.33 and 27.05 mg kg⁻¹. The high concentration of copper in the soil between 0 and 30cm deep indicates that copper does not spread widely after being released in the soil and, as a result of its low mobility, applied copper tends to collect in soil. Similar copper levels have been found in urban soils, agricultural soils, and oil field soils worldwide (Enegeide and Chukwuma, 2018; Chao et. al., 2014).

3.1.4 Effect of Iron (Fe) concentration on depth of soil

Figure 3.1 and Figure 3.2 indicates a small variation in the amount of iron in the study area A and the control site C. Iron (Fe), a vital element in soil, is a severe environmental risk when it surpasses plant requirements, according to Chen et al., (2014). The study area had Iron (Fe) concentrations that were lower than those of background (control) and are also below the maximum permissible limits of 5.0mg/kg. The levels of Iron (Fe) observed in study area sites range from 10.375 to 11.50 mg/kg were low when compared to the maximum permissible limits of 42.5mg/kg (Table 4.1). The leachates from rusted metal scraps or vehicle body pieces that were left outside the mechanic shop for a long time, in which iron is the predominant component, may be the cause of the elevated levels of Fe (Edori and Edori, 2012). The iron levels discovered in this work were relatively low in comparison to the iron levels identified in soil profiles from auto workshops (Enegeide and Chukwuma, 2018; Alfred et al., 2013);

3.1.5 Effect of Lead (Pb) concentration on depth of soil

The amount of Lead detected in the study area A is little amount in depths and also the amount of Lead found in the control site C, as shown in Figure 3.1 and Figure 3.2, despite the fact that Lead is a very dangerous heavy metal that interferes with a range of plant physiological systems (Najeeb et al., 2014). Lead levels were typically low across all locations which were far lower compared to the highest permitted limits of 85 mg/kg (see Appendix), these numbers fell below the USEPA's (1986) range of 30-300mg/kg for agricultural soils. Similar to that, certain places in Nigeria have seen low amounts of (Pb) (Iwegbue 2013;). Lead (Pb) concentrations were stated as being highly

elevated in the soil and to have above the reference levels were discovered by (Farombi et al., 2013; Obini et al., 2013), Iyama et. al., (2022), likewise noted higher Pb content in IAUE, followed by Uniport, preceding RSUST, with values that fell within the same ranges as those seen in Kaduna, Nigeria, drain soils (Mohammed and Folorunsho, 2015). However, these results were less than those seen in past studies (Kacholi and Sahu, 2018; Fosu-Mensah et. al., 2017).

3.1.6 Effect of Zinc (Zn) concentration on depth of soil

Zinc is a necessary component for plants, although it can be hazardous in large doses, according to Broadley et. al., (2007). Figures 3.1 and Figures 3.2 shows that there is a small difference in the concentration of zinc in the study area A compared to the control site C. Zinc (Zn) levels in the study area ranged from 10.75 to 13.18 mg/kg (Table 3.1), which is far lower than the highest permitted limits of 85 mg/kg (see Appendix). The amounts of zinc discovered in this investigation were relatively low in comparison to the levels of zinc reported for soil profiles of auto workshops (Anegebe et al., 2018; Kawo et al., 2017), however substantially higher levels of Zinc in soil have been recorded for some sites in Nigeria (Enegeide and Chukwuma, 2018; Duru et. al., 2010). Similar to this, low quantities of Zinc have been found in surface soils, agricultural soil, and soils of municipal trash dumps (Swidwa-Urba'nska and Jorge Battle-Sales, 2021; Afolabi and Eludoyin, 2021; Ugbebor and Ntesat, 2013).

3.2 Effect of depth on soil Physicochemical properties at Mgbuka Obosi Mechanic Village, Obosi

3.2.1 Effect of soil pH on depth

Table 3.1 illustrates that the soil pH at locations A (the study area) and C differs slightly at $P < 0.05$ (control site). At site A, the pH of the soil drops with depth, and at site C, the control site, the pH also lowers with depth. According to Alloway and Aryes (1997), the majority of soils in the tropics range from acidic to barely neutral, hence the pH values of the two places ranged from 5.80 to 6.10. The soil pH values at the research location and the control site differed slightly (Table 3.1), when compared to the pH values at the control site, the pH values in the study area had the highest values and decreased in depth (Table 3.1). The soil pH values of the study area at 0 – 30cm (6.10) and at 30 – 60cm (6.00) shows that the area is slightly acidic, while the soil pH values of the control site ranging between 5.80 – 5.85 shows that the control site is moderately acidic.

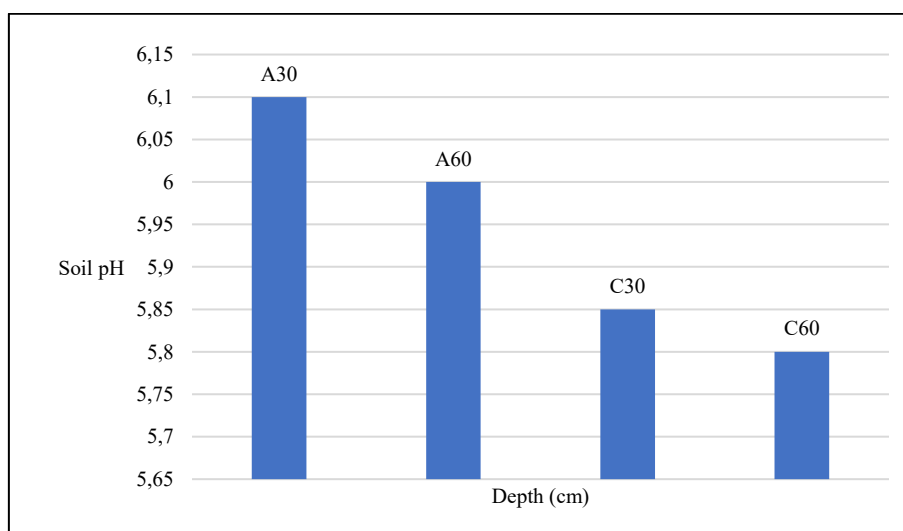


Figure 3.3: Effect of depth on Soil pH

3.2.2 Effect of depth on Soil Moisture

Table 3.1 shows that at $P < 0.05$ the effect of depth on soil moisture on location A increased at 0-30cm and decreased at 30-60cm depth while at the control location C, the soil moisture increased at 30-60cm depth but reduces at 0-30cm depth of location C which shows that location C has higher soil moisture content than location A. There was a little difference between the soil moisture values at the study area and the control site (Table 3.1). The values of moisture content in control soil ranged between 8.50% – 9.80% while that of the polluted soil ranged between 7.07% – 6.24% ($p < 0.05$). According to Njoku et al., (2008), automobile oil spillage reduces soil moisture availability or holding capacity, or increases moisture deficit in soils, hence the reason why the soil moisture availability is lower at the study area at depth 30-60cm when compared to the control site 30-60cm soil depth.

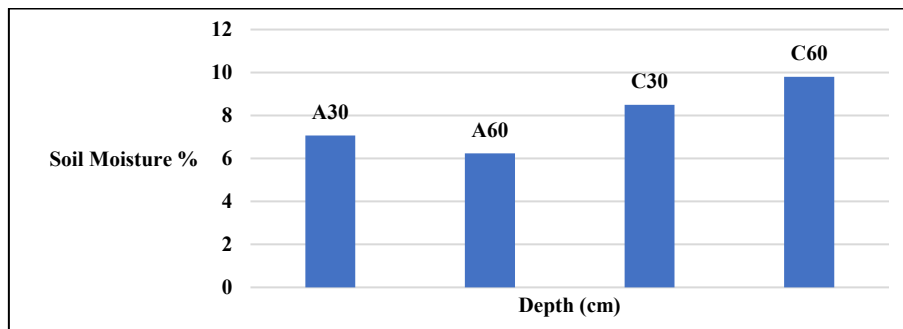


Figure 3.4: Effect of depth on Soil Moisture

3.2.3 Effect of depth on Soil Particle Size

The soil particle size as shown in Table 3.1 indicates that there is a little difference at $P < 0.05$ of soil particle size at location A 0-30cm depth to compare to the soil density of location C at 0-30cm depth, there is also a little difference of the soil particle size between A 30-60cm depth and C 30-60cm depth.

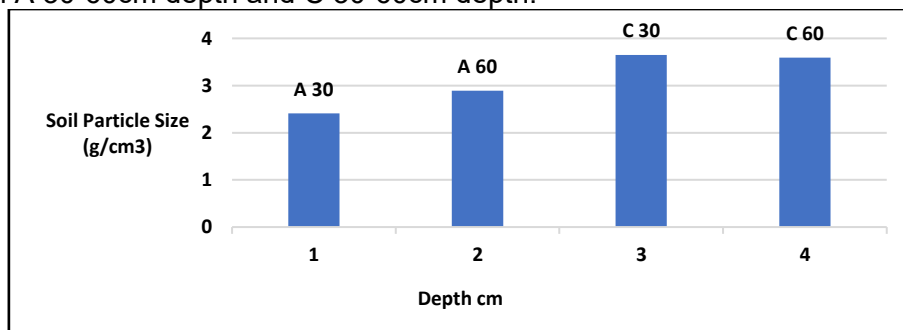


Figure 3.5: Effect of depth on Soil Particle Size

The soil particle size at the study area and the control site (see Table 3.1), showed that there is a decrease with increase in depth in the study area when compared to the control site where there is an increase with increase in depth. Which implies that the porosity was slightly high at the top soil of the control site than at the study area due to the consistent activity going on at the mechanic village.

3.2.4 Effect of depth on Soil Density

The soil density as shown in Table 3.1 indicates that there is a big difference at $P < 0.05$ of soil density at location A 0-30cm depth to compare to the soil density of location C at 0-30cm depth. There is a little difference between the soil density at Location A 30-60cm depth and location C 30-60cm depth.

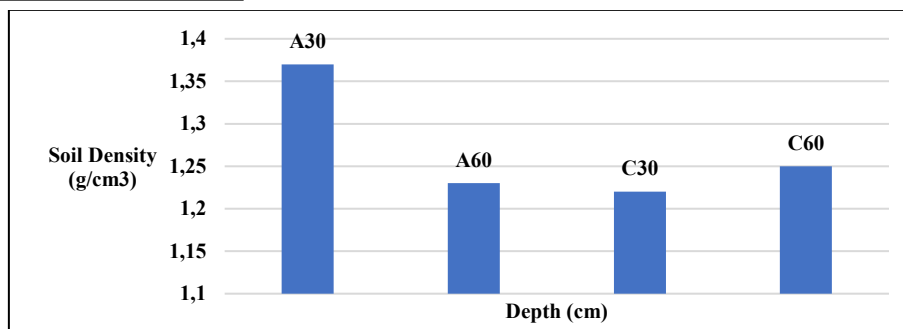


Figure 3.6: Effect of depth on Soil Density

From the results, the bulk density of soil samples is generally moderate, ranging between 1.22 – 1.37%, with soil density being regarded as the dry mass (weight) of soil per bulk volume, the bulk densities increased with depth at the control site while reduced in depth at the study area. Bulk densities above 1.75 mg/kg for sands are seen as causing hindrance to root penetration in the soil, (Michael and Donald, 1996).

3.2.5 Effect of depth on Soil Organic Carbon

Table 3.1 showed that there is a large difference of the Soil Organic Carbon at P <0-05 at depths 0-30cm and 30-60cm at locations A and C.

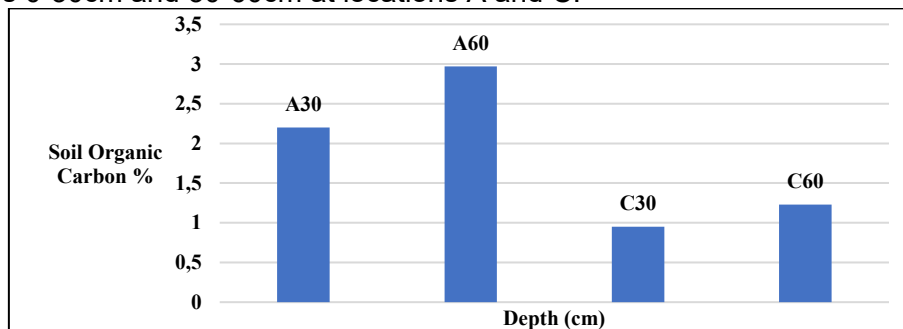


Figure 3.7: Effect of depth on Soil Organic Carbon

The functional groups available for complexation with the metals increase in proportion to the amount of organic carbon in the soil, increasing retention. According to Table 3.1, the organic carbon of the soil in the current study ranged from 0.95% to 2.97% for both the study region and the control site, showing minimal metal retention in the topsoil. The soil samples' organic carbon concentrations were higher than 0.75%, which indicates that they were fertile (FAO, 2017).

3.2.6 Effect of depth on soil Nitrogen (N), Phosphorus (P) and Potassium (K)

The amount of Nitrogen (N) found in the study area A 0-30cm is significantly lower than the amount of Nitrogen (N) found at the control site C 0-30cm as shown in figure 4.8, this also occurred in the results of the amount of Nitrogen (N) found in study area A 30-60cm and at the control site C 30-60cm. The amount of Phosphorus (P) found in the study area A 0-30cm is higher compared to the amount of Phosphorus (P) found at the control site C 0-30cm as shown in figure 4.8, this is also observed in the results of the amount of Phosphorus (P) found in study area A 30-60cm and at the control site C30-60cm. The is a little difference on the amount of Potassium (K) found in the study area A 0-30cm compared to the amount of Potassium (K) found at the control site C 0-30cm as shown in figure 4.8, this also occurred in the results of the amount of Potassium (K) found in study area A 30-60cm and at the control site C30-60cm.

Phosphorus (P) and Potassium (K) were significantly higher in the oil affected soils than in the control soils to compare to Nitrogen (N) which the values are slightly

higher in the control soils than in the automobile mechanic village. It has been established that petroleum-based contamination in soil leads to reduction in the two major organic nutrients; nitrate – nitrogen and phosphate – phosphorus (Paul and Clark, 1996). There is also compelling evidence on the effect of chemical pollutants (e.g., heavy metals) on the N and P cycle due mainly to the interruption of microbial functions in these processes by those pollutants (Wang et al., 2007; Kapoor et al., 2015). Nitrogen (N) is considered as important regulating factor for heavy metal mobility and availability for plants by soil acidification. However, excessive nitrogen is reported to inhibit the metabolism of plant nitrogen compounds that perform signal functions (Nagajyoti et al. 2010).

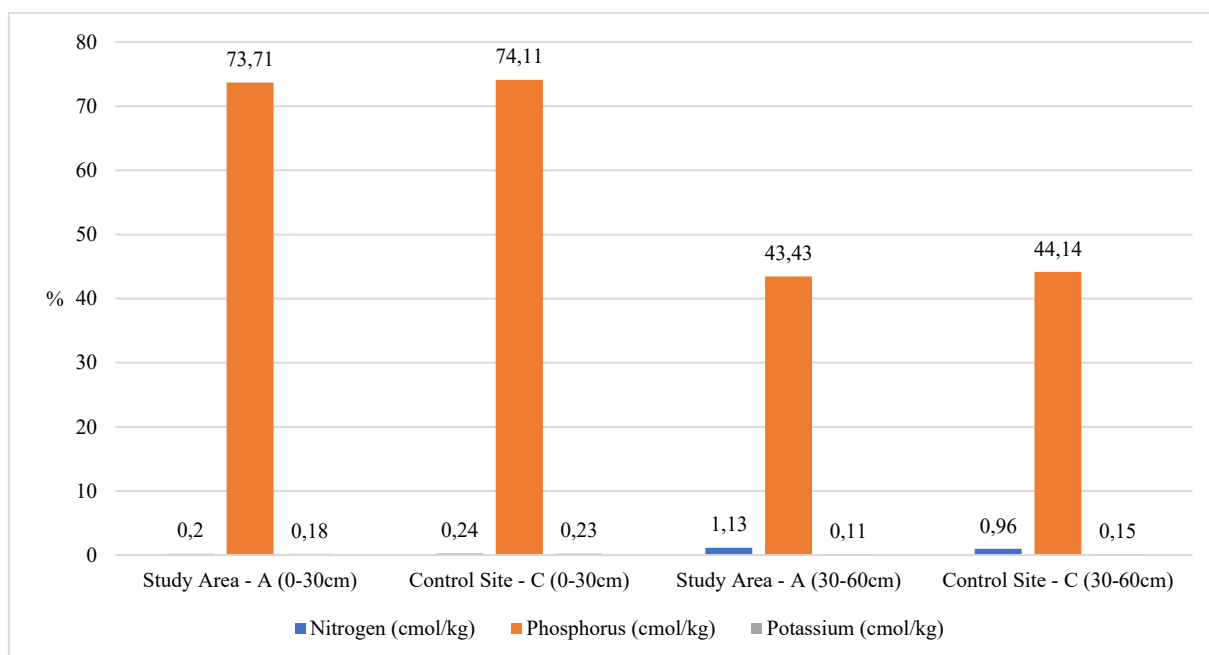


Figure 3.8: Concentration of Nitrogen (N), Phosphorus (P) and Potassium (K) at depths in Mgbuka Obosi mechanic village, Obosi

3.3 Data on Contamination Factor (CF) and Pollution Load Index (PLI)

Table 3.2: Contamination Factor (CF) and Pollution Load Index (PLI) of heavy metals found in the topsoil at Mgbuka Obosi Mechanic Village Obosi, Anambra State, Nigeria

Depth	Contamination Factor (CF) %						Pollution Load Index (PLI)
	Cd	Cr	Cu	Fe	Pb	Zn	
A (0-30cm Depth)	1.353	0.137	1.34	2.758	1.40	1.693	0.271
A (30-60cm Depth)	1.773	0.129	1.33	2.541	1.735	2.598	0.582

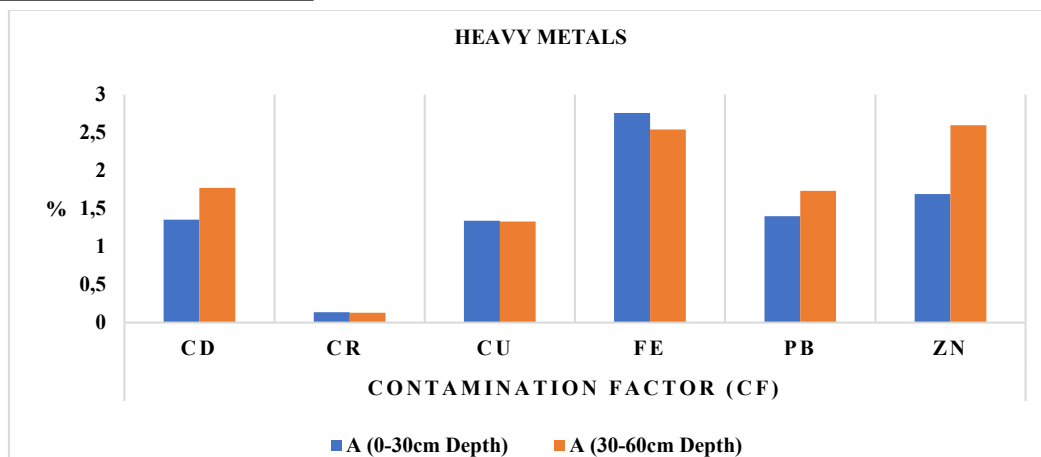


Figure 3.9: Contamination Factor (CF)

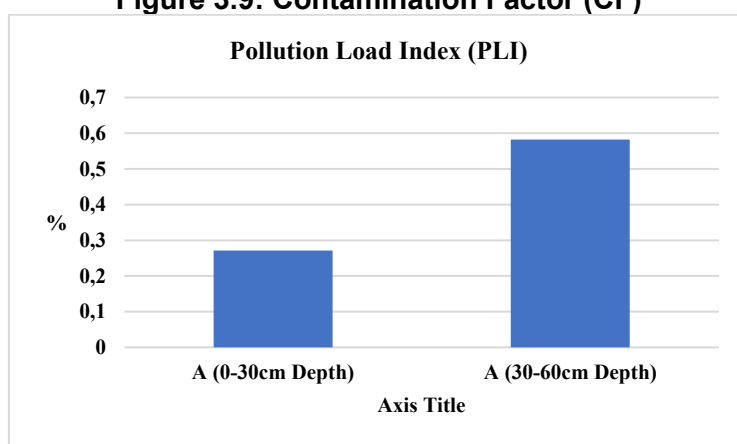


Figure 3.10: Pollution Load Index (PLI)

The Contamination Factor (CF) values increased with an increase in depth except for Copper (Cu) and Iron (Fe) wherein their values declined with rise in depth. Although Zn>Fe>Cd>Pb>Cu>Cr is the order of contamination at depths of 30-60 cm, Fe>Zn>Pb>Cd>Fe>Cu is the order of contamination at depths of 0-30 cm. The two groups into which the CF were divided are shown in Table 3.2. Only Chromium (Cr) has the CF value that is less than “1” which indicates that there is a little presence of Chromium (Cr) in the study area and the control area, while the other heavy metals (Cadmium, Copper, Iron, Lead and Zinc) have CF values that are more than “1” which indicates that the presence of these heavy metals (Cadmium, Copper, Iron, Lead and Zinc) contamination in the study area and the control site are moderate according to the classification of CF of heavy metals by (Afolabi and Eludoyin, 2021; Swidwa-Urbańska and Jorge Battle-Sales, 2021; Alfred et. al., 2013).

The pollution load index values show with increase in depth, there is an increase in contamination level of the heavy metals in the top soils thereby endangering farming activities by farmers who live around Mgbuka Obosi Mechanic Village Obosi, Anambra State. The contamination factor values of this work revealed that the topsoil at Mgbuka Obosi Mechanic Village is heavily contaminated with Cd, Cr, Cu, Fe, Pd and Zn (see Table 3.2). this is due to the illegal contamination by indiscriminate discharge of condemned engine oils, battery acids, motor chemicals, paints etc. which were releases heavy metals into the bare soil. Also, the pollution load index (PLI) values of the soil at the study area were high, which calls for the need of an immediate intervention to ameliorate pollution at the study area to prevent the contamination from being transported to the surrounding farm lands. The CF values is in relative with the work of

Afolabi and Eludoyin (2021) in the research work on the evaluation of heavy metals and contamination status of soil around abandoned and active Nigerian dumpsites, and the PLI values are also high in relative when compared to the result of Opara et. al., (2020) who researched on an assessment of the impact of auto-mechanic activities on groundwater in Diobu, Port-Harcourt, Nigeria. Agricultural products growing on soils with high heavy metal concentrations at all levels are harmful to humans, animal health and the bio-environment.

3.4 Data on Enrichment Factor (EF)

Table 3.3: Enrichment Factor (EF) of heavy metals found in the topsoil at Mgbuka Obosi Mechanic Village Obosi, Anambra State, Nigeria

Depth	Enrichment Factor (EF)				
	Cd	Cr	Cu	Pb	Zn
A (0-30cm Depth)	0.488	0.053	0.486	0.504	0.613
A (30-60cm Depth)	0.701	0.047	0.524	0.682	1.023

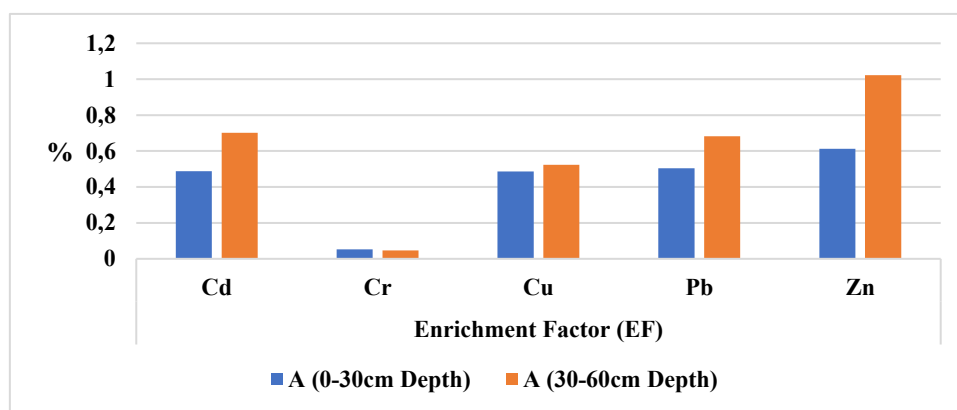


Figure 3.11: Enrichment Factor (EF)

CONCLUSION

The levels of Cd, Cu, Fe, Pb, and Zn in the study area at Mgbuka Obosi mechanic village, Obosi were higher than those at the control site, indicating that Cu and Fe had the highest concentrations in the soil layers while Cr had the lowest concentration. Cu>Fe>Zn>Pb>Cd>Cr is the order of concentration that was found in this research. In this research it was observed that Cd, and Cu concentrations are slightly lower than maximum permissible limits, while the values of Cr, Fe, Pb and Zn were very far below the maximum permissible limits (see Appendix). The effects of selected heavy metals on soil physicochemical properties in this work showed that the soil pH is moderately acidic, low availability of moisture at the study area than at the control site. The soil porosity is slightly high at the control site when compared to the study area, and the soil density is moderate and the control site is more fertile for agricultural purposes according to the soil organic carbon result. To stop the activities that are increasing the concentration of heavy metals in the surrounding farmlands, there is an urgent need for serious intervention from both the public sector, private sector and the government.

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